UNIVERSITY OF HYDERABAD
ENTRANCE EXAMINATION – 200X
M. Sc. Chemistry

TIME: 2 HOURS **MAXIMUM MARKS: 100**

HALL TICKET NUMBER

INSTRUCTIONS

1. Write your HALL TICKET NUMBER in the space provided above and also in the OMR ANSWER SHEET given to you.
2. Make sure that pages numbered from 1 – 13 are present (excluding pages assigned for rough work).
3. There are 100 questions in this paper. All questions carry equal marks.
4. **There is negative marking. Each wrong answer carries -¼ mark.**
5. Answers are to be marked on the OMR answer sheet following the instructions provided there upon.
6. Hand over both the question paper booklet and OMR answer sheet at the end of the examination.
7. In case of a tie, the marks obtained in the first 25 questions (PART A) will be used to determine the order of merit.
8. No additional sheets will be provided. Rough work can be done in the space provided at the end of the booklet.
9. Calculators (non-programmable) are allowed.

PART A

1. Which of the following compounds has pyramidal geometry?

(A) $B(CH_3)_3$ (B) $(CH_3)_3C^+$ (C) $(CH_3)_3N$ (D) BF_3

2. Which of the following compounds exhibits optical isomerism?

(A) 1-Chloropentane (B) 1,5-Dichloropentane
(C) 3-Chloropentane (D) 2-Chloropentane

3. Identify the atom-economy reaction from the following.

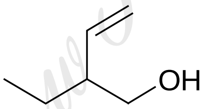
(A) Grignard reaction (B) Wittig reaction
(C) Diels-Alder reaction (D) Friedel-Crafts reaction

4. Chiral molecule B has $[\alpha]_D^{20}$ = +24 for 40% optical purity with (R)-configuration. What will be $[\alpha]_D^{20}$ of the molecule B with (S)-configuration having 100% optical purity?

(A) -30 (B) +30 (C) +60 (D) -60

5. The correct order of stability of carbocations is:

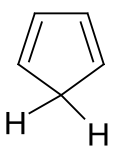
(A) $CH_3^+ > (CH_3)_2CH^+ > CH_3CH_2^+ > (CH_3)_3C^+$
(B) $(CH_3)_3C^+ > (CH_3)_2CH^+ > CH_3CH_2^+ > CH_3^+$
(C) $(CH_3)_3C^+ > (CH_3)_2CH^+ > CH_3^+ > CH_3CH_2^+$
(D) $CH_3CH_2^+ > CH_3^+ > (CH_3)_3C^+ > (CH_3)_2CH^+$

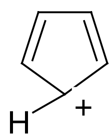
6. The IUPAC name of 

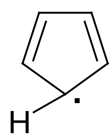
is:

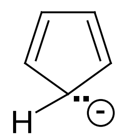
(A) Vinylethyl alcohol (B) 3-Ethylbut-3-en-1-ol
(C) 2- Ethylbut-3-en-1-ol (D) 2-Ethenylbutanol

7. Which of the following is aromatic?

(A) 

(B) 

(C) 

(D) 

8. The coordination number of a metal ion situated at the center of a square antiprism of ligand atoms is:

(A) 2 (B) 4 (C) 6 (D) 8

9. The strongest base among the following is:

(A) AsH_3 (B) PH_3 (C) NH_3 (D) SbH_3

10. The qualitative test of "phosphate" is performed in the presence of an acid and

(A) Vanadate (B) Arsenate (C) Permanganate (D) Molybdate

11. Which of the following is associated with the "layer type" structure?

(A) Graphite (B) Diamond (C) Fullerene (D) None of these

12. Which of the following pairs cannot be used to produce hydrogen?

(A) Copper and hydrochloric acid (B) Sodium and ethanol

(C) Iron and sulfuric acid (D) Iron and steam

13. Which of the following elements is associated with nitrogen fixing enzyme?

(A) Calcium (B) Nickel (C) Molybdenum (D) Cobalt

14. In eastern part of India and in Bangladesh many people are affected (skin symptom) by drinking water that contains the toxic element

(A) Hg (B) Sb (C) As (D) Se

15. For which of the following sets of values of ΔH and ΔS will a reaction be spontaneous at 50^{o} C ?

	ΔH (kJ)	**ΔS (J/K)**
(A)	+10	+30
(B)	+10	- 30
(C)	- 10	+30
(D)	- 10	-30

16. $Hg^{2+} + 2e^{-} \rightarrow Hg$ $E^{0} = 0.85$ V

$Zn^{2+} + 2e^{-} \rightarrow Zn$ $E^{0} = - 0.76$ V

Given the cell potentials shown above, the overall cell potential for the following reaction is

$$Zn + Hg^{2+} \rightleftharpoons Zn^{2+} + Hg$$

(A) 0.09 V (B) 1.61 V (C) 0.80 V (D) 0.18 V

17. Half lifetime ($t_{1/2}$) of a second order reaction is proportional to (where A_0 is the initial concentration of reactant)

(A) A_0 (B) A_0^2 (C) $1/A_0$ (D) Independent of A_0

18. The equivalent conductance ($ohm^{-1}cm^{2}eqv.^{-1}$) at infinite dilution (Λ_0) of acetic acid (HAc) will be [Given Λ_0 (HCl) = 420, Λ_0 (NaCl) = 126 and Λ_0 (NaAc) = 91]:

(A) 385 (B) 637 (C) 455 (D) 203

19. 20 ml of 0.2 M NaOH and 40 ml of 0.1 M H_2SO_4 are mixed together in a standard flask and made up to 250 ml. The pH of the resultant solution is closest to:

(A) 5 (B) 6 (C) 7 (D) 8

20. Copper crystallizes in an *fcc* lattice with sides 3.61 Å. Atomic weight of copper is 63.54. The density of copper can be estimated as:

(A) 3.25 (B) 7.80 (C) 8.97 (D) 9.20

21. A shell leaves the gun barrel with a speed of 25 ms^{-1} at an angle of 45^o from the horizon. Its trajectory (height vs horizontal distance travelled) is

(A) Straight line (B) Circle (C) Parabola (D) Hyperbola

22. The unit vector perpendicular to the plane defined by the two vectors $(i + j + k)$ and $(i - j - k)$ is

(A) $(i - j) / \sqrt{2}$ (B) $(j - k) / \sqrt{2}$ (C) $(k - i) / \sqrt{2}$ (D) $(i - j + k) / \sqrt{3}$

23. If $x^2 + y^2 + 4x - 6y + k = 0$ represents a circle of radius 5 the value of k is

(A) 12 (B) -12 (C) 10 (D) -10

24. In the binary scale the number 55 is represented by

(A) 111001 (B) 110111 (C) 010101 (D) 101010

25. $\int_0^{\pi} \sin^2 \theta \, d\theta =$

(A) 0 (B) $\pi/4$ (C) $\pi/2$ (D) π

PART B

26. The strongest acid among the following is:

(A) CH_3OH (B) CH_3NH_2

(C) CH_3SH (D) $CH_3CH_2NH_2$

27. The compound with lowest boiling point is

(A) 2-Methylhexane (B) 3,3-Dimethylpentane

(C) n-Heptane (D) Cycloheptane

28. Identify the fastest reacting compound in an S_N^2 reaction with OH^-.

(A) *tert*. Butyl chloride (B) Ethyl chloride

(C) 2,2-Dimethyl-1-propyl chloride (D) Isopropyl chloride

29. A compound that will give two isomeric olefins on reaction with NaOMe will be:

(A) 1-Bromohexane (B) 3-Bromopentane

(C) Bromocyclohexane (D) 1-Phenyl-1-bromoethane

30. Identify the most appropriate reagent for the conversion of benzamide to benzylamine.

(A) $NaBH_4$ (B) $LiAlH_4$ (C) $Pd/C/H_2$ (D) KH

31. Identify the most appropriate C-C bond forming reaction involving the carbocation intermediate.

(A) Cannizzaro reaction (B) Favorskii rearrangement

(D) Friedel-Crafts reaction (D) Benzoin condensation

32. Identify the achiral molecule from the following.

(A) 2-Amino-2-carboxypropane (B) Alanine

(C) 2-Phenylpentane (D) Lactic acid

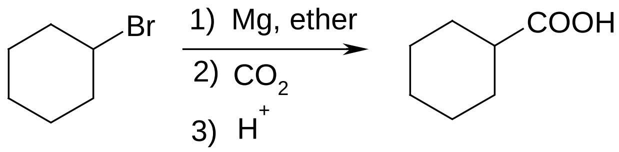
33. Identify the most appropriate product in the reaction of RCOOH with diazomethane.

(A) RCH_2COOH (B) RCH_2OH

(C) $RCOOCH_3$ (D) $RCOCH_3$

34. $CH_3CH_2I \xrightarrow{N_3^-} CH_3CH_2N_3 + I^-$ is an example of following reaction type:

(A) S_N^1 (B) S_N^2 (C) S_E^1 (D) S_E^2

35. 

is an example of:

(A) Kolbe reaction (B) Cannizzaro reaction

(C) Grignard reaction (D) Perkin condensation

36. Identify the alcohol which would be most easily dehydrated among the choices given.

(A) $CH_3CH_2CH_2CH_2OH$ (B) $CH_3CH_2CH(OH)CH_3$

(C) $(CH_3)_2C(OH)CH_2CH_3$ (D) $(CH_3)_2CHCH(OH)CH_3$

37. The stability of formation of free radicals is in the following order:

(A) Tertiary > Secondary > Primary > Methyl

(B) Tertiary > Primary > Secondary > Methyl

(C) Methyl > Tertiary > Secondary > Primary

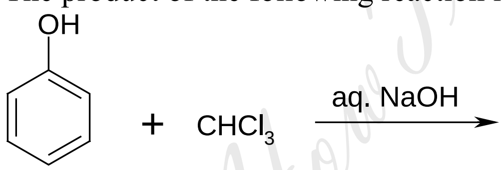
(D) Methyl > Primary > Secondary > Tertiary

38. Identify the products that would be formed when acetophenone is reacted with I_2 and NaOH.

(A) $CH_3COOH + PhI$ (B) $PhCOONa + CH_3I$

(C) $PhCOONa + CHI_3$ (D) $PhCOONa + CH_3COONa$

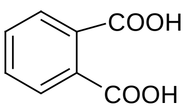
39. The product of the following reaction is:

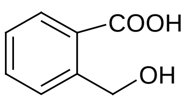


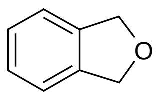
(A) *o*-Hydroxybenzaldehyde (B) *o*-Chlorophenol

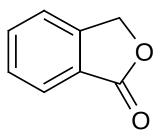
(C) Benzoquinone (D)*p*-Hydroxyphenol

40. The product formed when phthalic anhydride is treated with Zn/acetic acid is:

(A) 

(B) 

(C) 

(D) 

41. What is the reagent used for the conversion of $RCOCH_2R'$ to $RCOCOR'$?

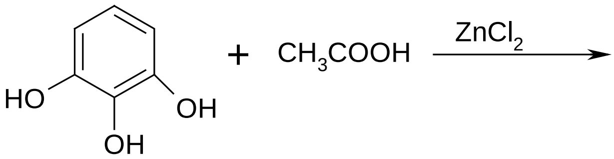
(A) H_2O_2 (B) SeO_2 (C) OsO_4 (D) HNO_3/H_2SO_4

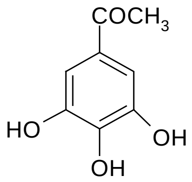
42. Sucrose on hydrolysis with diluted acids gives

(A) D(+)-Glucose and D(-)-Fructose (B) D(-)-Glucose and D(-)-Fructose

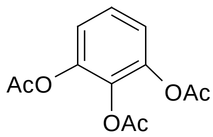
(C) D(+)-Glucose and L(-)-Fructose (D) 2 molecules of D(+)-Glucose

43. Predict the product of the following reaction.





(A)



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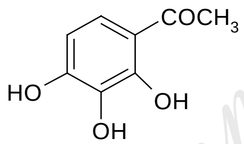
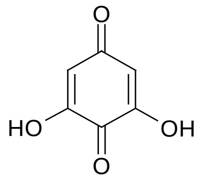


(C)



(D)

44. The degree of unsaturation of the fatty acid is determined by:

(A) Acid value (B) Iodine value

(C) Acetyl value (D) Reichert-Meissl value

45. The conversion of silver salt of the carboxylic acid to alkyl halide is called:

(A) Hunsdiecker reaction (B) Stephen reaction

(C) Ritter reaction (D) Vilsmeier reaction

46. Complete the following nuclear reaction by identifying the missing product.

$^{14}_{7}N + \alpha \rightarrow \quad ? + ^{1}_{1}H$

(A) $^{17}_{8}O$ (B) β^{-} (C) β^{+} (D) $^{16}_{8}O$

47. Select the group of ions corresponding to the larger ion from each pair.
$[Co^{2+}, Co^{3+}]$, $[Fe^{2+}, Zn^{2+}]$, $[Na^{+}, F^{-}]$, $[O^{2-}, S^{2-}]$

(A) $Co^{2+}, Zn^{2+}, F^{-}, S^{2-}$ (B) $Co^{3+}, Fe^{2+}, Na^{+}, S^{2-}$

(C) $Co^{2+}, Fe^{2+}, F^{-}, S^{2-}$ (D) $Co^{3+}, Zn^{2+}, Na^{+}, O^{2-}$

48. Complete the sentence: An octahedral complex, MA_4B_2 _______________.

(A) Will have two constitutional isomers (B) Will have two stereoisomers

(C) Can not show isomerism (D) Will be optically active

49. Which two of the following molecules/ions have **planar** structures?
(i) XeF_4 (ii) ClO_4^{-} (iii) $PtCl_4^{-}$ (iv) MnO_4^{-}

(A) i and iii (B) i and ii (C) ii and iii (D) ii and iv

50 When ammonium hydroxide is added to an aqueous solution of copper sulfate, the color of the solution becomes a deeper blue. The reaction taking place is best described as:

(A) Redox (B) Rearrangement (C) Addition (D) Substitution

51. In acid medium one mole of Fe^{2+} will be equivalent to how many moles of MnO_4^-?

(A) 5 moles (B) 1/5 moles (C) 2 moles (D) 1/2 moles

52. The products obtained when chlorine reacts with cold and dilute solution of sodium hydroxide are:

(A) $Cl^- + ClO_2^-$ (B) $Cl^- + ClO^-$

(C) $Cl^- + ClO_3^-$ (D) $Cl^- + ClO_4^-$

53. The oxidation states of **boron** in B_2Cl_4 and **oxygen** in hydrogen peroxide are, respectively,

(A) +2 and −2 (B) +3 and −1

(C) +2 and −1 (D) +3 and −2

54. 25.4 g of iodine and 14.2 g of chlorine are made to react completely to form a mixture of ICl and ICl_3. The masses of ICl and ICl_3 produced are:

(A) 16.25 g and 7.1 g respectively (B) 32.5 g and 7.1 g respectively

(C) 16.25 g and 23.35 g respectively (D) 25.4 g and 23.35 g respectively

55. Arrange the following in the order of decreasing size: Ca^{2+}, S^{2-}, Ar, Cl^-

(A) $Cl^- < S^{2-} < Ar < Ca^{2+}$ (B) $Ca^{2+} < Cl^- < S^{2-} < Ar$

(C) $Ca^{2+} < S^{2-} < Ar < Cl^-$ (D) $Ca^{2+} < Ar < Cl^- < S^{2-}$

56. Arrange the following in the order of increasing covalent character:
NaF, NaCl, LiCl, LiBr, LiI

(A) NaF, LiCl, NaCl, LiBr, LiI (B) LiI, LiBr, LiCl, NaCl, NaF

(C) NaF, NaCl, LiCl, LiBr, LiI (D) NaCl, NaF, LiI, LiBr, LiCl

57. Arrange the following in the order of increasing boiling points: HF, HCl, HBr, HI

(A) HI < HCl < HBr < HF (B) HF < HBr < HCl < HI

(C) HCl < HBr < HI < HF (D) HCl < HF < HBr < HI

58. Among the following, which two do not contain sulfur?
Galena, Cassiterite, Stibnite, Rutile, Realgar, Cinnabar

(A) Stibnite and Rutile (B) Realgar and Cassiterite

(C) Galena and Cinnabar (D) Rutile and Cassiterite

59. Which of the following is called the **third allotrope of carbon**?

(A) Graphite (B) Fullerene (C) Diamond (D) Carbon nanotube

60. The **Cubic** unit cell is defined by:

(A) $a \neq b \neq c$, $\alpha = \beta = \gamma = 90^o$ (B) $a = b = c$, $\alpha = \beta = \gamma = 90^o$

(C) $a = b \neq c$, $\alpha = \beta = 90^o$, $\gamma = 120^o$ (D) $a = b = c$, $\alpha \neq \beta \neq \gamma$

61. In the compound $[S_2Mo_5O_{23}]^{4-}$, the oxidation state of sulfur is:

(A) 0 (B) +2 (C) +4 (D) +6

62. How many grams of magnesium sulfide are formed by reacting 0.20 moles of magnesium and 12.8 g of sulfur, if atomic weights of Mg and S are 24 and 32, respectively?

(A) 13.0 (B) 11.2 (C) 12.8 (D) 17.6

63. Which of the following elements can exist in dry air without reacting?

(A) White P (B) Rb (C) Ca (D) Ag

64. The metal ion electronic configuration in high-spin octahedral $[CoF_6]^{3-}$ is:

(A) $t_{2g}^3 eg^3$ (B) $t_{2g}^4 eg^2$ (C) $t_{2g}^5 eg^1$ (D) $t_{2g}^6 eg^0$

65. The metal ion that has zero magnetic moment is:

(A) Cu^{2+} (B) Cr^{3+} (C) V^{5+} (D) Mo^{5+}

66. Solutions of the following compounds, all at the same molality, were prepared in a given solvent. Which solution has the lowest freezing point?

(A) KBr (B) $Al(NO_3)_3$ (C) $NaNO_2$ (D) $MgCl_2$

67. A closed vessel maintained at a constant temperature of 0 °C contains a mixture of water and ice. The number of degrees of freedom available to the system is:

(A) 0 (B) 1 (C) 2 (D) 3

68. Units of the van der Waals' gas constants, a and b, are respectively:

(A) lit^2 atm $mole^{-2}$ and lit $mole^{-1}$ (B) atm lit^{-2} $mole^2$ and lit^{-1} mole

(C) atm^{-1} lit^2 $mole^{-1}$ and lit $mole^{-1}$ (D) atm lit^{-1} $mole^2$ and lit^{-1} mole

69. The Maxwell relation $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$ implies that for a perfect gas

(A) $S \propto R \ln V$ (B) $S \propto RT \ln V$

(C) $S \propto \frac{RT}{V^2}$ (D) $S \propto RT \ln P$

70. A 0.5 molal aqueous solution of glucose melts at 272.22 K. The melting point of a 1 molal solution of sucrose will be (Clue: melting point of ice is: 273.15 K):

(A) 271.29 K (B) 272.22 K (C) 269.43 K (D) 272.68 K

71. The charge of 0.4 mol of electron is equal to:

(A) -5.79×10^4 C (B) -1.00×10^4 C

(C) -0.4×10^4 C (D) -3.86×10^4 C

72. 6.5 mg of a hydrocarbon on combustion gives 11.2 ml of CO_2 and 4.5 ml of water vapour at STP. The empirical formula of the hydrocarbon is:

(A) C_5H_8 (B) C_5H_6 (C) C_5H_4 (D) C_5H_2

73. The latent heat of melting of a solid is 330 J gm^{-1} at its melting point (300 K). The change in the entropy of a 2.0 gm sample when it melts at 300 K is:

(A) 0.55 JK^{-1} (B) 2.2 JK^{-1} (C) 0.45 JK^{-1} (D) 0.9 JK^{-1}

74. The rate law for the single-step reaction, $A + 2B \rightarrow C$ is:

(A) k [C] (B) $k\,[C]/\{[A]\,[B]^2\}$

(C) $k\,[A]\,[B]^2 / [C]$ (D) $k\,[A]\,[B]^2$

75. The heats of formation of CO and CO_2 are – 110.5 and – 393.5 kJ/mol, respectively. The heat of reaction of $CO + \frac{1}{2} O_2 \rightarrow CO_2$ is

(A) -283 kJ/mole (B) -141.5 kJ/mole (C) + 141.5 kJ/mole (D) +283 kJ/mole

76. Boron doped silicon is:

(A) An intrinsic semiconductor (B) A p – type semiconductor

(C) An n – type semiconductor (D) A superconductor

77. The entropy change in an isolated system for a reversible process is:

(A) High (B) Low (C) Zero (D) Indeterminable

78. The product of the melting point and the entropy of fusion at constant pressure is called:

(A) Gibbs free energy (B) Enthalpy of fusion

(C) Helmholtz free energy (D) Specific heat

79. The bond dissociation energy is in the following order:

(A) O – H > H – H > N – H > C – C

(B) C – C > N – H > H – H > O – H

(C) O – H > H – H > C – C > N – H

(D) C – C > O – H > H – H > N – H

80. Several metal oxides exist in nonstoichiometric state. In a sample having the formula $TiO_{1.1}$, the ratio of Ti^{3+} / Ti^{2+} is:

(A) 0.10 (B) 0.25 (C) 0.33 (D) 0.67

81. If the 1st and 2nd Balmer lines of the hydrogen atom appear at 1.523×10^4 and 2.056×10^4 cm^{-1}. The 3rd line should appear at:

(A) 2.216×10^4 cm^{-1} (B) 2.303×10^4 cm^{-1}

(C) 2.504×10^4 cm^{-1} (D) 2.775×10^4 cm^{-1}

82. The de Broglie wavelength of an electron ($m_e = 9.109 \times 10^{-31}$ Kg) traveling at a speed of 2.998×10^6 ms^{-1} is (given h = 6.626×10^{-34} Js):

(A) 1.215×10^{-10} m (B) 3.645×10^{-10} m

(C) 2.43×10^{-10} m (D) 4.86×10^{-10} m

83. The process of dispersion of a precipitate into colloidal state is called:

(A) Coagulation (B) Tyndall Effect

(C) Flocculation (D) Peptisation

84. A 0.001 M solution of a substance has an absorbance of 0.1 at a given wavelength with a 1 cm pathlength cuvette. The molar extinction coefficient at this wavelength is:

(A) 10 M^{-1}cm^{-1} (B) 100 M^{-1}cm^{-1} (C) 1 M^{-1}cm^{-1} (D) 1000 M^{-1}cm^{-1}

85. Two compounds A and B, which interact reversibly to form a complex AB were mixed in a vessel at equal ratio. If the resultant concentration of each compound at the time of mixing is 0.21 M and after equilibrium is established the complex concentration is 0.2 M, the association constant K_a is:

(A) 2.0×10^0 M^{-1} (B) 2.0×10^1 M^{-1}

(C) 2.0×10^2 M^{-1} (D) 2.0×10^3 M^{-1}

86. $\int_{-2}^{2} dx/(16 - x^2) =$

(A) ln ¾ (B) 3 ln ¼ (C) ¼ ln 3 (D) 4 ln 1/3

87. The area of the triangle with vertices P(2, -3, 1), Q(1, -1, 2), R(-1, 2, 3) is:

(A) $\sqrt{2}/3$ (B) $2\sqrt{3}$ (C) $3\sqrt{2}$ (D) $\sqrt{3}/2$

88. The complex number $(1 - \sqrt{3}\, i)$ in polar form reads

(A) 2 cis 5π/3 (B) 2 cis 0 (C) 2 cis 3π/3 (D) 2 cis π/3

89. If two distinct numbers are chosen randomly from the first 50 natural numbers, the probability that both numbers are divisible by 6 is:

(A) 4/175 (B) 4/25 (C) 16/625 (D) 16/1175

90. The value of the sum $\sum_{r=0}^{4} {}^4C_r\, 2^{-r}$ is:

(A) 16/81 (B) 4/9 (C) 9/4 (D) 81/16

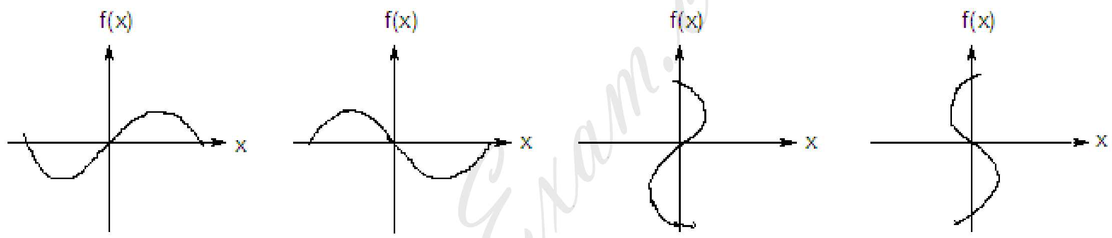
91. $\lim_{x \to 0} x^{\sin x} =$

(A) 0 (B) ∞ (C) 1 (D) Does not exist

92. The rank of the matrix $\begin{vmatrix} 3 & 1 & 4 \\ 0 & 5 & 8 \\ -3 & 4 & 4 \end{vmatrix}$ is:

(A) 0 (B) 1 (C) 2 (D) 3

93. The graph of f(x) = sin x/(2-cos x) ($-\pi \le x \le \pi$) is



(A) (B) (C) (D)

94. $\int \cos\sqrt{x}/\sqrt{x}\ dx =$

(A) $2\cos\sqrt{x} + c$ (B) $2\sin\sqrt{x} + c$

(C) $2\sec\sqrt{x} + c$ (D) $2\,\text{cosec}\sqrt{x} + c$

95. The inverse of the matrix $\begin{vmatrix} 0 & i \\ i & 0 \end{vmatrix}$ is:

(A) $\begin{vmatrix} 0 & i \\ i & 0 \end{vmatrix}$ (B) $\begin{vmatrix} 0 & i \\ -i & 0 \end{vmatrix}$ (C) $\begin{vmatrix} 0 & -i \\ i & 0 \end{vmatrix}$ (D) $\begin{vmatrix} 0 & -i \\ -i & 0 \end{vmatrix}$

96. The number of real roots of the equation $x^3 - 2x^2 + 2x = 0$ is:

(A) 0 (B) 1 (C) 2 (D) 3

97. The function with at least one local minimum among the following is:

(A) e^{-x^2} (B) e^{-x} (C) e^{x} (D) e^{x^2}

98. A discontinuous function among the following is:

(A) Sin x (B) Cos x (C) Tan x (D) e^x

99. Consider a sphere and a cube of maximum volume that can be cut out of the sphere. The ratio of the volume of the sphere to that of the cube is:

(A) 1/2 (B) π/2 (C) 1/3 (D) π/3

100. If $A = \begin{vmatrix} 1 & -i \\ -i & -1 \end{vmatrix}$, $AA^T =$

(A) 1 (B) i (C) -1 (D) 0